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THE EFFECTS OF LATITUDE AND ALTITUDE ON BIRD WEIGHTS

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This paper compares bird weights from Mopeia, Zambezi delta, Mozambique (17°56'S., 35°37'E.), altitude 12m and Nchalo, Lower Shire Valley, Malawi (16°16'S., 34°55'E.), altitude 60m, with those discussed by Britton (1977) from western and coastal Kenya. The climate of Nchalo and Mopeia are similar although Nchalo has a lower rainfall, lower humidity and a slightly higher mean annual temperature. No specimens have been collected but it is likely that the same subspecies occur in both areas, except that in *Tchagra senegala*¹, *Camaroptera brachyura* and *Lonchura cucullata*, authorities differ on the amount of subspeciation, if any, shown by birds from the two localities (Benson & Benson 1977, Clancey 1971, SAOS List Committee 1969).

¹ English names are given in Table 1.

TABLE 1

Weights of birds from Nchalo, Malawi (N) and Mopeia, Mozambique (M).
Sexes are given as (m) and (f) where applicable. The first figure is the
number of birds in the sample followed by the range of weights (g) and,
in brackets, the mean and standard deviation

<i>Colius striatus</i>	Speckled Mousebird
N: 247, 41-60 (50.6 ± 4.1).	M: 15, 48-62 (52.7 ± 4.4).
<i>Tohagra australis</i>	Brown-headed Bush Shrike
N: 18, 27-36 (31.0 ± 3.2).	M: 28, 29-39 (33.7 ± 2.3) P<0.005.
<i>Tohagra senegala</i>	Black-headed Bush Shrike
N: 1, 55.	M: 6, 48-53 (51.2 ± 1.7).
<i>Laniarius ferrugineus</i>	Tropical Boubou
N: 17, 42-53 (48.0 ± 3.5).	M: 32, 40-55 (47.8 ± 3.8).
<i>Cossypha heuglini</i>	White-browed Robin Chat
N: 19, 29-41 (36.5 ± 3.5).	M: 9, 30-40 (36.1 ± 2.9).
<i>Prinia subflava</i>	Tawny-flanked Prinia
N: 34, 7.0-9.2 (8.14 ± 0.63).	
<i>Camaroptera brachyura</i>	Grey/Green-backed Camaroptera
N: 51, 8.0-11.5 (10.19 ± 0.82).	M: 11, 10.1-13.1 (11.23 ± 1.13) P<0.01.
<i>Antheptes collaris</i>	Collared Sunbird
N (m): 7, 6.0-7.1 (6.71 ± 0.35).	M (m): 4, 7.0-8.5 (7.80 ± 0.68) P<0.02.
N (f): 3, 6.0-6.8 (6.33 ± 0.42).	M (f): 1, 7.5.
<i>Nectarinia bifasciata</i>	Little Purple-banded Sunbird
N (m): 12, 6.6-8.1 (7.18 ± 0.50).	M (m): 3, 7.1-8.2 (7.77 ± 0.59).
N (f): 9, 6.0-7.4 (6.62 ± 0.43).	M (f): 1, 7.5.
<i>Ploceus ocularis</i>	Spectacled Weaver
N (m): 12, 23-26 (24.5 ± 1.2).	M (m): 5, 26-30 (27.2 ± 1.8) P<0.01.
N (f): 16, 21-30 (23.7 ± 2.5).	M (f): 12, 22-28 (24.4 ± 2.0).
<i>Ploceus cucullatus</i>	Black-headed Weaver
N (m): 402, 33-46 (37.5 ± 2.3).	M (m): 18, 33-43 (37.2 ± 2.4).
N (f): 223, 26-37 (31.7 ± 2.0).	M (f): 24, 26-37 (31.3 ± 3.2).
<i>Euplectes axillaris</i>	Fan-tailed Widowbird
N (m): 12, 22-28 (25.2 ± 2.0).	M (m): 4, 22-27 (25.0 ± 2.2).
N (f): 21, 17-23 (18.7 ± 1.5).	
<i>Euplectes hordeaceus</i>	Black-winged Bishop
N (m): 11, 23-28 (25.1 ± 1.6).	M (m): 3, 26-28 (27.0 ± 1.0).
N (f): 7, 18-21 (19.6 ± 1.1).	
<i>Lagonosticta senegala</i>	Red-billed Firefinch
N (m): 31, 6.6-8.4 (7.54 ± 0.46).	M (m): 17, 6.8-9.7 (8.31 ± 0.88) P<0.005.
N (f): 35, 6.0-9.8 (7.69 ± 0.80).	M (f): 18, 6.0-9.1 (7.82 ± 0.80).
<i>Lonchura cucullata</i>	Bronze Mannikin
N: 49, 7.0-10.3 (8.62 ± 1.28).	M: 41, 7.0-11.0 (9.15 ± 0.96) P<0.02.

All species discussed by Britton (1977) were caught at Nchalo or Mopeia except *Nectarinia olivacea* and *Estrilda bengala*; *Prinia subflava* was caught only at Nchalo and only males of *Euplectes axillaris* and *hordeaceus* at Mopeia. All weights were taken on Pesola spring balances, to 1g in larger birds and to 0.1g in smaller species. Known immatures are excluded but recaptures of the same individual are used except when made on the same day. The time of capture was not recorded at Mopeia nor in the early days at Nchalo; however, as trapping hours, net sites and pro-

portions of birds caught morning and afternoon are similar, it is possible to compare weights from the two localities. My data may not be properly comparable with Britton's but they should still form a basis for discussion.

As would be expected, weights from Nchalo and Mopeia are mostly very similar, however, in four species (*Tehagra australis*, *Camaroptera brachyura*, *Ploceus ocularis* and *Lagonosticta senegala*) weights from Nchalo are significantly lighter. Where a level of significance is given in Table 1 it is derived from the *t*-test. Mean weights for all four localities are given in Table 2 and compared using the *t*-test; where differences are significant they are marked <.

TABLE 2

Mean weights of birds from four localities, showing where differences are significant ($P < 0.01$). C = Coastal Kenya, K = Nyanza, Kenya, N = Nchalo, Malawi, and M = Mopeia, Mozambique. Weights in brackets indicate a single weight only. '<' indicates a significant difference in weight between the localities on either side of this sign

<i>Colius striatus</i>		C 46.3 <	N 50.6 <	K 52.4	M 52.7	
<i>Tehagra australis</i>		N 31.0	C 32.2	M 33.7 <	K 37.0	(N < M)
<i>Tehagra senegala</i>		C 48.3	K 49.6	M 51.2	N (55)	
<i>Laniarius ferrugineus</i>		C 46.8	M 47.8	N 48.0 <	K 57.6	
<i>Cossypha heuglini</i>		C 27.7 <	M 36.1	N 36.5 <	K 41.7	
<i>Prinia subflava</i>		C 8.08	N 8.14 <	K 9.07		
<i>Camaroptera brachyura</i>		C 9.29 <	N 10.19 <	M 11.23	K 11.45	
<i>Anthreptes collaris</i>	m:	N 6.71	C 6.84 <	M 7.88	K 8.30	
	f:	N 6.33	C 6.73	M (7.5)	K (8.0)	
<i>Nectarinia bifasciata</i>	m:	C 6.97	K 7.13	N 7.18	M 7.77	
	f:	C 6.23	K 6.28	N 6.62	M (7.5)	
<i>Ploceus ocularis</i>	m:	C 23.1	N 24.5 <	K 26.1	M 27.2	
	f:	C 22.9	N 23.7	K 24.0	M 24.4	
<i>Ploceus cucullatus</i>	m:	C 36.7	M 37.2	N 37.5 <	K 45.2	
	f:	C 28.6 <	M 31.3	N 31.7 <	K 36.6	
<i>Euplectes arillaris</i>	m:	M 25.0	N 25.2	K 26.5 <	C 29.1	
	f:		N 18.7 <	K 20.9 <	C 22.4	
<i>Euplectes hordeaceus</i>	m:	K 20.4 <	C 24.1	N 25.1	M 27.0	
	f:	K 18.4	C 18.5	N 19.6		
<i>Lagonosticta senegala</i>	m:	C 7.19	N 7.54 <	K 8.27	M 8.31	
	f:	C 7.46	N 7.69	M 7.82 <	K 8.39	
<i>Lonchura cucullata</i>		C 8.07	N 8.62	M 9.15	K 9.16	(C < M) (N < K)

DISCUSSION

Britton (1977) showed that 14 out of the 17 species examined averaged heavier in western Kenya localities near the equator at elevations between 1160 and 1550 m, than birds from sea-level at the coast 3-4°S. As would be expected from Bergmann's Rule and Britton's data, most Nchalo and Mopeia birds were on average heavier than samples from the Kenya coast (Table 2). It is evident that 12-14° of latitude are enough to account for significant differences in weight when virtually no altitudinal difference is involved. Most Nchalo and Mopeia birds are on average lighter than the samples from highland Kenya near the equator, so that the altitudinal effect of 1160-1550 m is greater than the latitudinal difference involved (16-17°) on weight. Nevertheless, there is a considerable variation in pattern as can be seen in Table 2 and two species, *Tohagra senegala* and *Nectarinia bifasciata*, show no significant difference between the four localities (neither do females of *Ploceus ocularis* and *Euplectes hordeaceus*, but this may be due to different proportions of gravid females).

Table 1 shows the weights of birds from Nchalo and Mopeia: since the localities are only 200 km apart and Mopeia is 1°40' further south and 48 m lower than Nchalo, one would not expect any differences of size to result from these small altitudinal and latitudinal differences, however, there were significant weight differences in four species while two, *Anthreptes collaris* and *Lonchura cucullata*, show slight differences. Many factors could influence weight and size but it is difficult to point to any one as the cause. There is a possibility of subspecific difference in *Camaroptera brachyura* and *Lonchura cucullata* but not in the other four species, although there could be geographic separation of two nearly resident populations leading to the formation of different races. Climate may also have some effect on nearly resident populations. The mean annual temperature at Mopeia is 24.9°C (Hanmer 1976) and that of Nchalo 25.6°C. The annual average rainfall of Mopeia is 960 mm (Hanmer 1976) while that of Nchalo is 660 mm, i.e. Nchalo is both hotter and drier than Mopeia. Of the six species involved, three are insect-eaters and three seed-eaters so that differences in vegetation are unlikely to be a major cause of weight differences.

Further studies on the effects of altitude, latitude, climate and geographical location would be of considerable interest to determine which factors are of most importance in weight and size variations in different localities.

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OBSERVATIONS ON THE NESTING OF THE THREE-BANDED PLOVER

CHARADRIUS TRICOLLARIS

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While I was being detained by guerillas between June 1976 and early January 1977, observations were made of a pair of Three-banded Plovers which occurred on an 800 m stretch of a small, shallow river in north-east Eritrea. The river flowed in part of a sandy wadi, at one point passing through a narrow gorge; here there were several small waterfalls and two deeper pools. Between the falls was a series of tiny tributaries from hot springs at one edge of the wadi. Down-river from the lower pool the wadi widened and, after c.300 m, the river disappeared into the sand. Occasional flash floods temporarily filled the whole width of the wadi with water. Nomads with their camels and goat herds frequently visited the wadi for water and, in the early mornings and evenings, a stream of guerillas, sometimes numbering well over a hundred individuals, passed up and down the wadi.

The pair of plovers was first seen on 8 June and daily thereafter, usually feeding by the river below the second pool or up in the springs area. When disturbed, the birds were reluctant to fly but ran quickly along the edge of the river, bobbing up and down whenever they paused. A small scrape cleared of large pebbles and lined with small ones was found between the river and a cliff on 17 June. One egg was laid during 24 June and a plover was incubating on 25 June. The nest was not disturbed until 29 June when the incubating bird was flushed to establish the clutch size, which was one. Mackworth-Praed & Grant (1957) give the clutch size for most small African *Charadrius* species as two or rarely three, but Harrison (1975) noted that in Kittlitz's Sand Plover *C. pecuarius* the clutch, although usually two, is occasionally one.

My movements were very restricted by the guerillas and visits to the river were only allowed in the evenings. Observations were therefore usually made during half to one hour periods each evening between 15.00 and 18.00 hrs local time (dusk was c.19.15 hrs in June), occasionally earlier. Probably because observations were made at a relatively cool time of the day I did not see adults crouching during incubation, feather-raising or belly-soaking - patterns of behaviour associated with heat loss from adults during incubation (Reynolds 1977). No change-over of the adults at the nest was seen either. In other *Charadrius* species it is known that both sexes share incubation and it is probable that the Three-banded Plover is no exception. The incubating bird was very tame, sometimes allowing an approach to within 3 m before slipping off the nest and running quickly to the edge of the river, soon returning to the egg when danger had passed. When disturbed from its nest, the Three-banded Plover never kicked or scuffled sand or stones over the egg to cover it, as does the Kittlitz's Sand Plover and sometimes the White-fronted Sand Plover